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State of the Art and Latest Advances in Exploring Business Models for Nature-Based Solutions

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Abstract: Nature-based solutions (NBS) offer multiple solutions to urban challenges simultaneously, but realising funding for NBS remains a challenge. When the concept of NBS for societal challenges was first defined by the EC in 2017, financing was recognised as one of the major challenges to its mainstreaming. The complexity of NBS finance has its origin in the multiple benefits/stakeholders involved, which obscures the argument for both public and private sector investment. Since 2017, subsequent waves of EU research- and innovation-funded projects have substantially contributed to the knowledge base of funding and business models for NBS, particularly in the urban context. Collaborating and sharing knowledge through an EU Task Force, this first set of EU projects laid important knowledge foundations, reviewing existing literature, and compiling empirical evidence of different financing approaches and the business models that underpinned them. The second set of EU innovation actions advanced this knowledge base, developing and testing new implementation models, business model tools, and approaches. This paper presents the findings of these projects from a business model perspective to improve our understanding of the value propositions of NBS to support their mainstreaming.

Keywords: sustainable business models; nature-based solutions; urban planning; NBS implementation

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1. Introduction

The concept of 'nature-based solutions' (NBS) promotes increased visibility of the multiple values and benefits that nature offers for society, shifting the narrative of nature as a 'cost' to society towards a 'solution' for a broad range of sustainability challenges [1]. This ability of NBS to realise multiple (co-)benefits towards different sectors, addressing multiple sustainability challenges at once, can potentially lead to cost-efficient solutions to complex societal problems, such as the increased pressure on limited resources due to urbanisation, biodiversity loss, and climate adaptation/mitigation [2]. Despite the increasing recognition of their strategic role in the shift towards a green and climate-resilient economy, a number

of challenges hinder NBS uptake and mainstreaming. The most significant challenges relate to financial, institutional, and governance barriers linked to particular characteristics of NBS compared to grey solutions.

A first financial challenge relates to the fact that a significant proportion of funding for nature historically originates from public sector budgets [3]. These budgets are under sustained pressure, increasingly due to the impact of COVID-19. Even before the pandemic exacerbated public funding, NBS often competed for funding with other public services, such as health or education, creating budget allocation dilemmas for local governments [4–6]. Despite increasing evidence of their multi-functionality and cross-sectoral benefits, public budgets for NBS investment are often insufficient to drive their mainstreaming [7].

One reason for this lack of collaboration across public sector departments and agencies is the widely acknowledged silo gaps in the public sector [8–10]. Responsibility for NBS planning and implementation often resides in one public sector department/agency, such as planning or greening. While these departments demonstrate high levels of knowledge and support for NBS, they often lack knowledge of financing and business models for NBS. These knowledge gaps lead to path dependency on existing (public sector) funding channels and a lack of confidence in experimenting with alternative financing approaches. Conversely, the financing/economics departments of public sector organisations hold a high level of knowledge about public sector and hybrid financing instruments but lack knowledge of the multiple value propositions of NBS and the potential to capture such value [11]. Therefore, a major challenge identified is the need to develop capacity-building tools to increase knowledge and awareness of NBS business models across stakeholder groups, both in public sector agencies and with external stakeholders.

An overview of NBS cases in Europe revealed that local authority's budgets represent the lion's share of investment in NBS, although a relatively high incidence of hybrid financing of NBS is also documented [12]. Private investment in NBS is still low, amongst other things, due to a lower level of awareness of NBS in the private sector compared with the public sector. The scale of individual NBS projects (often less than 500,000 EUR) is too small for private sector investors, suggesting that a portfolio approach (bundling multiple NBS projects for investment) might be needed.

In-depth attempts are being undertaken to express nature's value, both in monetary and non-monetary terms [13–15]. However, there remains a significant gap between articulating the value of nature and finding stakeholders who are actually willing to pay for nature—in particular, in the private sector. One of the key challenges encountered in research on (urban) NBS is the fact that the benefits are 'scattered' between stakeholders, with NBS only becoming cost-efficient if public and private contributions are coordinated [16]. Individual stakeholders are interested in different NBS benefits, with trade-offs rarely considered [17]. Often, investment in NBS does not weigh up when only one or two of its benefits are taken into account. The difficulty of monetising socio-ecological benefits raises additional challenges for private investors. Furthermore, NBS often fall into the category of common-pool resources or public goods, with benefits accruing to multiple stakeholders while the majority of public NBS benefit particular interests [18]. Given the 'public good' nature of many NBS, there is a lack of clarity on investment return/performance and a lack of widely accepted and implemented indicators that could communicate the social and environmental impact of NBS [9,17].

Another important challenge is the predominant focus on securing financing for the capital investment phase of NBS implementation. Unlike grey infrastructure solutions which depreciate over time, NBS appreciate over time but require ongoing financing of operational or stewardship costs (see Figure 1). Generating revenue to sustain ongoing costs should be addressed as part of the overall business model. Long-term business models should also recognise the transition of NBS' governance towards collaborative governance models over time, which requires taking into account the engagement of multiple stakeholders in creating, delivering, and capturing value.

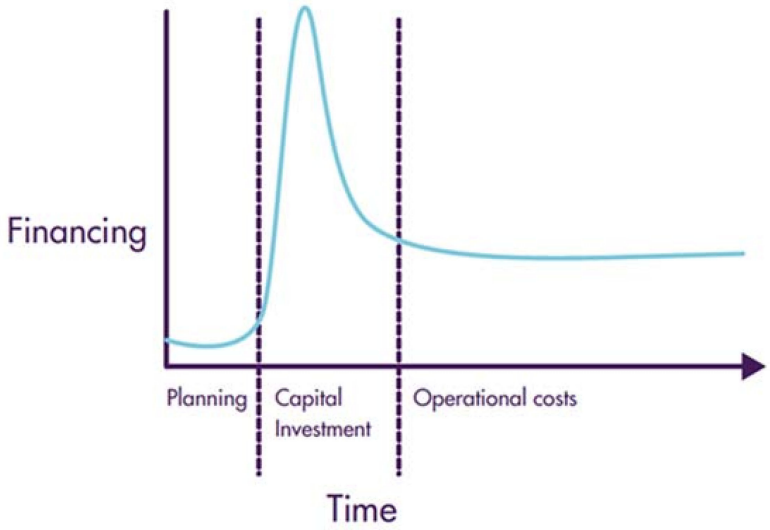

Figure 1. The connecting nature 'Heartbeat' model for financing nature-based solutions. Adapted from [11].

Overall, the set of described challenges—lack of funding for NBS, difficulty in capturing their multiple benefits for cost-efficiencies, and need to involve private stakeholders in financing—has stimulated current efforts to analyse the particularities of NBS' value proposition, delivery, and capture through the lens of business model theory.

The business model concept was developed in the 1960s to describe value creation, delivery, and capture models for firms, but it is increasingly being applied to different domains [19]. One of the most widely used definitions states that 'business models describe the rationale of how an organisation creates, delivers, and captures value' [20]. In the corporate world, 'value' is traditionally conceptualised as economic/financial performance [21]. The concept of value has evolved, and companies are increasingly required by society to contribute to the creation of shared value [22].

Recently, the concept of 'business models for sustainability (BMfS) was introduced by several authors [22–24], while others proposed 'sustainable business model archetypes' [25]. These strands of literature propose the development of financially profitable value propositions that also radically reduce negative and/or create positive external effects for the natural environment and society [23].

The initiative to adapt and apply the concept of business models to the context of NBS emerged around 2014–2016, when the European Commission launched a call within the Horison 2020 (H2020) programme for research and innovation aiming to address the multiple knowledge gaps and uncertainties associated with NBS [2]. The need to advance knowledge of business models for NBS was identified as a critical research need, given the innovativeness of the concept and the wish to attract increasing amounts of funding, particularly from private actors. Five years later, the research presented in this article emerged within the European Commission's Task Force III working group on 'business models and financing for NBS'. The research initiative had the objective to compile and evaluate the advances made by the most important H2020 projects, addressing the research question of 'how have H2020 projects contributed to advance knowledge in the potential application of the business models concept to NBS in order to support building the case for financing and implementation'. As a result, this article presents the contributions from a set of H2020 projects that have addressed the NBS business models knowledge gap from different angles, and provides an overview of findings and tools that have produced a solid knowledge baseline on business models for NBS and their enabling conditions.

2. Materials and Methods

This scoping study was conducted within the research cluster entitled *Horison 2020 NBS Task Force 3*, one of four research clusters launched by the European Commission to collaborate and work across and beyond the H2020 projects on the topic of NBS. *Task Force 3* gathers and connects representatives across the projects working on business models, governance, financing, and procurement for NBS. The individual work, collective discussions, and activities held within this group have created a longitudinal expert group, leading to this scoping paper on business models for NBS. The following topics are explored: (i) the importance and role of business models for the implementation and mainstreaming of NBS projects, (ii) how business models interact and position with other relevant drivers, and (iii) an overview of the tools and resources developed across different H2020 projects on NBS business model-related knowledge, tools, and recommendations for application.

In this context, the first methodological step was the recruitment of expert authors within *Task Force 3*, representing knowledge produced on business models for NBS across different H2020 projects to jointly identify and select the most relevant topics Sections 3.1–3.4. This entailed setting up a common conceptual basis and understanding the terms and concepts based on a literature review previously undertaken by the different authors as part of their research. Second, selection and prioritisation of relevant topics covered across different H2020 projects addressing NBS business model-related knowledge gaps were carried out. The resulting four categories set the structure for the presentation of results in Section 3. Third, a literature review was carried out within each category to frame the state-of-the-art and knowledge limitations related to business models. Fourth, a meta-analysis of the advances developed within the projects provided an overview and guidance through the array of knowledge, tools, and outputs generated. These were grounded in relevant references to projects' articles and deliverables where further information can be found. Lastly, a collective brainstorming exercise was conducted to draw the main messages for discussion and final recommendations.

3. Results

Based on the above methodology, we outline our results within the following selected thematic categories: (1) role, value and typologies of NBS business models; (2) integrated approaches to governance, financing, and co-creation for NBS business models; (3) integrated planning as enabler or barrier for governance and financing contexts framing NBS business models; and (4) tools developed in H2020 for NBS model design, in response to these themes, as conceptualized in Figure 2.

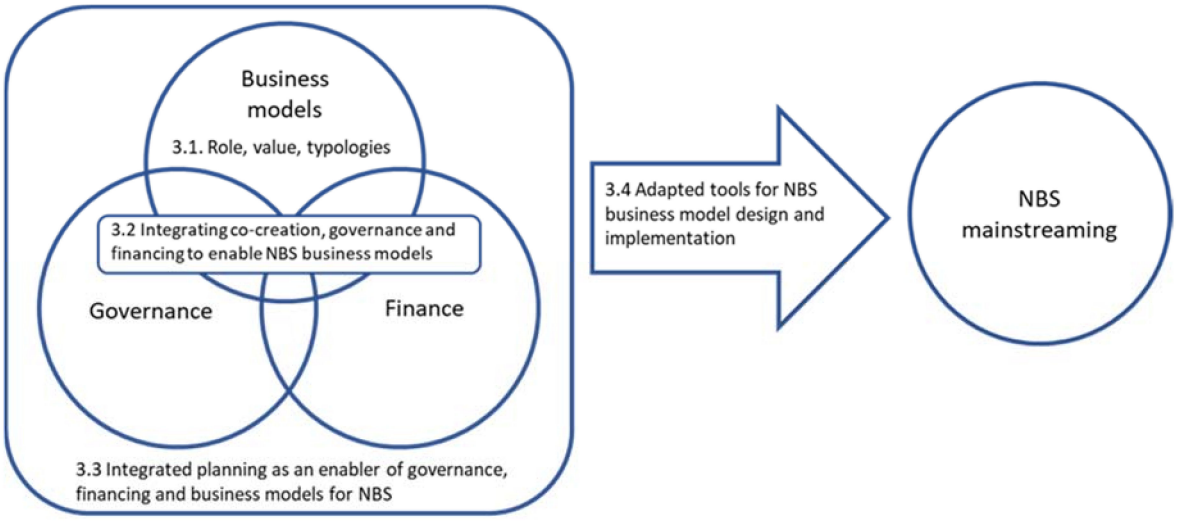

Figure 2. Thematic overview of results.

3.1. Role, Value, and Typologies of Business Models for NBS

The first key topic of research was the role and value of applying the business model concept to the mainstreaming of NBS. Business models for NBS highlight the value proposition of an NBS project and the elements required to deliver this value. Therefore, the value proposition, value creation and delivery, and value capture are three fundamental elements in the definition of a business model for NBS. The value proposition can be defined as the description of the value that NBS intend to create for citizens/city-users/local government/other stakeholders, and the identification of the needs NBS aim to address [22]. Value creation and delivery refer to the production of social, environmental, and economic benefits geared towards specific end-users through activities, channels, and partners [21]. Value capture is about how to earn revenues from the provision of goods, services, or information to users and customers [23].

These concepts assume even greater relevance in the definition of a business model for the implementation and maintenance of NBS. In fact, NBS are multifunctional and generate several benefits that are received/captured by different stakeholders. Some benefits are captured immediately by market actors (e.g., a decrease in energy consumption and an increase of real estate value due to greening). NBS delivers cost reductions in the long-term by reducing weather-related risks, such as flooding, drought, and extreme heat. These and other benefits, such as the aesthetic and the psychological value, leveraging social cohesion, and the reduction of health risks, are not fully captured by markets. Connecting Nature and other projects have shown the multiple benefits generated by nature-based enterprises involved in the implementation of NBS—both economic benefits (such as jobs and wealth creation) and non-economic benefits (such as environmental education or community engagement) [24]. In other words, the positive and negative externalities generated by NBS are not internalised by market prices [15]. In light of this, it is difficult to involve private stakeholders in the financing of NBS, and consequently, the most widely diffused business models attribute a leading role to public authorities either through a direct (e.g., involvement in the design/provision/delivery of the solution), or indirect intervention (e.g., setting up the regulatory framework that enables the NBS). In this respect, public authorities can try to remedy market failures through policy instruments aimed at valuing the benefits generated by NBS. The inclusion of the social and environmental value generated by NBS can help articulate business models in which the prevailing public financing model stimulates private investments; for example, the public authority allows a return on the investment through fiscal instruments (e.g., fees, charges, taxes).

The concept of public value for NBS projects is multi-faceted since it comprises different types of values. This value can benefit different stakeholders, each with their specific interests and motivations, and it can be delivered over different periods [25].

In the Naturvation project, eight business models for urban NBS were derived based on empirical evidence from 54 in-depth case studies of urban NBS across 18 cities, of which 12 were in Europe [26,27] (see Table 1). Analysis of these cases showed that multiple business models often jointly support the funding of a single NBS, and that value propositions were directed at different stakeholders [27].

A subset of urban NBS are edible city solutions (ECS) studied by the EdiCitNet project, which includes all forms of productive urban landscapes. Edible City Solutions are a wide scope of measures that leverage the city's regeneration, whether building-related or contributing to visibility and education. ECS suffered from their status as a leisure activity (in Western Europe) initiated by private actors, lacking administrative, or municipal support and acknowledgement [28]. In Europe, peri-urban agriculture mostly supports household income, combining self-consumption with sales in the local market. The EdiCitNet project examined clustered ECS along a value chain and researched different business models for different value propositions. A major project aim was to consolidate and stabilise ECS in their different maturity stages, if necessary, or to enlarge their portfolio of value propositions. The project distinguished four value propositions of ECS (Table 2).

Table 1. Business models for urban nature-based solutions (adapted from [27]).

Business Models	Description
Risk reduction model	The risk reduction model reduces financial risks by building resilience towards adverse environmental events through infrastructure changes.
Green densification model	The green densification model increases real estate value through greening cities.
Urban offsetting model	The urban offsetting model captures monetary flows from negative environmental impacts, re-routing this to re-invest into urban nature.
Green health model	The green health model employs active involvement with green spaces to improve citizens' physical and/or mental health.
Local stewardship model	The local stewardship model empowers citizens and local businesses to foster nature in their local area by offering their resources (money, time).
Vacant space model	The vacant space model facilitates the well-being of citizens through low-cost access to underutilised terrains.
Green heritage model	The green heritage model enables preservation and utilisation of pre-existing natural heritage sites through recreational access.
Green education model	The green education model facilitates the environmental education of (often young) citizens, building a culture of connectedness to nature.

Table 2. Categories of ECS value propositions.

Categories of ECS Value Propositions	Description
Services for production	Preparational services and products for soil, substrates or intangible goods such as knowledge exchange and training.
Production of crops	The most important one is still urban agriculture; the production of crops in cities is not limited to soil.
Harvesting and communities	Services around harvesting and communities have specific business models based on particular categories and typical shaping.
Knowledge, digital, and training	Outreach of ECS have special approaches.

In the Urban GreenUP project, the definition and adoption of business models for NBS in cities were analysed through a literature review of the best practices and case studies in EU and non-EU cities. The aim was to understand the structure and characteristics of successful NBS business models. For the analysis of business models, an assessment framework was defined, composed of two main blocks. The first block was related to general information about the project implemented, its objectives, and the main challenges faced by the city. The second block was related to the business model, namely, the stakeholders involved, the description of the value proposition, value delivery and value capture, the cost structures, and the revenues, among others. The Urban Greenup project carried out a stakeholder perception analysis, which showed that the definitions of value proposition, delivery, and capture could vary based on the considered NBS, as well as on the involved stakeholders. The analysis and identification of the values generated through the implementation of NBS in cities revealed hidden values, helping to define business models that can internalise the positive externalities of NBS. Table 3 describes the values attributed to different types of NBS by different stakeholders.

Table 3. Value attributed to NBS across three stakeholder categories [15,29].

Stakeholders	Value Proposition	Value Delivery	Value Capture
Values associated with green roofs and walls			
Public administration	Reduction of heat island effect	Creation of milder microclimate	Improvement of citizens health and comfort
Firms	Implementation of investments	Business opportunities (for utilities, it depends on public incentive schemes)	Increase of revenues
Citizens	Energy savings	Reduction of heating and cooling systems	Savings in energy bill
Values associated with sustainable urban drainage systems			
Public administration	Reduction of water run-off	Decrease in flooding events	Reduction of restoration costs
Firms	Protection of natural assets	Decrease in flood events	Insurance value
Citizens	Protection of residential areas	Decrease in flood events and well-being improvement	Improvement of overall neighbourhood and increase of property value
Values associated with tree planting			
Public administration	Reduction of the heat island effect	Increase of urban areas' liveability	Health improvement
Firms	Improvement of brand recognition	Business opportunities	Increase in area attractiveness and in the economic activity
Citizens	Tree cover in residential areas leading to health, aesthetic, and biodiversity benefits	Health benefits	Improvement of overall neighbourhood
Values associated with parks			
Public administration	Regeneration of neglected areas	Improvement of urban well-being and social cohesion	New businesses and new economic opportunities
Firms	Implementation of investments	Business opportunities (for utilities, it depends on public incentive schemes)	Increase of revenues
Citizens	Recreation	Improvement of health and well-being	Increase in value properties
Values associated with edible city solutions			
Public administration	Urban regeneration and social impacting edible space	Integrative and inclusive social impact in the urban area	Cost–benefit of micro and macro-economic harness
Firms	Resilient economic activities from small-scaled solutions to larger investments	Business and social entrepreneurship opportunities	Independent local economic structure providing local identity and socio-economic welfare
Citizens	Social cohesion and opportunities for interaction within and with nature in cities	Social well-being and areas of trust, neighbourhoods, and communities	Ecosystem and socio-economic services

3.2. Importance of an Integrated Approach to Co-Creation, Governance, and Financing for NBS Business Models at Different Scales

In analysing critical aspects influencing the generation of business models for NBS, three factors were identified across a number of H2020 projects as important interlinked leverage points (enablers or barriers), namely, governance, co-creation, and financing. This section presents the approaches of different projects to understand and guide their importance and role when exploring business models for NBS.

Regarding governance, NBS can trigger innovation and generate new ways of collaborating to implement NBS, sustain innovative NBS, and achieve economic sustainability.

To establish businesses and innovative start-ups that explore and capitalise on urban nature occurs in a particular context where national and local government provides crucial elements of the institutional framework, including the governance systems, political agenda

priorities, and institutions. Governance aims at the generic level to promote the well-being and progress in society through interventions that aim to change development tracks and behaviour of individual citizens and company actors, and of collective actors, including communities and NGOs, economic sectors and businesses associations, and public institutions. Governance entails networks for agenda-setting decision making, project development and implementation, involving business and multiple other societal actors, and thus also interests. Thus, from a governance perspective, the integration of NBS in public policy and steering involves interventions in not only urban nature but significantly just as much in the way societies interact with nature, which thus also entails balancing multiple and at times conflicting needs and interests of societal actors who have—or may have—a stake in nature as providing solutions either at a societal level or for nature per se. Thus, antagonist interests in urban nature and issues ridden with potential tension exist, and may smaterialise as barriers for NBS-based business incubation. Tensions reveal how NBS from a sustainable business and sustainable governance perspective, are social and economic, as well as linked to the natural environment.

Integrating real-life conditions and politics can be partly turned from a barrier to an enabler for inclusion of NBS in societal responses to great challenges, of which the transformation to green and sustainable post-carbon societies are moving high on the agenda in many member-states and cities, also prompted by a growing number of public policies and projects aimed at the UN SDG11 on Sustainable Cities and Communities. Urban nature is increasingly considered when public authorities and policymakers and semi-public and private actors involved in governance formulate approaches and establish measures to manage challenges.

Some authors have pointed out that to assess funding and business models, it is necessary to study the suitability of governance arrangements and the key actors involved [16,30,31]. Therefore, the definition of business models for the implementation of NBS projects can benefit from an integrated approach that studies the actors together with the available resources and their interactions [32]. To maximise the NBS' innovative platforms, adaptive public policy with participation of local business and stakeholders, and the possibilities of the accepted implementation of NBS projects, is necessary to adapt them to their specific local socio-ecological contexts [33].

To this end, the Nature4Cities project (N4C) used the implementation model (IM) concept to consider governance, financing, and business dimensions in an integrated way through two connected approaches: a conceptual and operational integration. An implementation model is defined as 'the combination of governance, business, and financial models under which the NBS is planned, developed and managed' [34]. The conceptual integration involves the characterisation and mapping of the models based on their suitability for NBS projects and the extent of involvement of three main stakeholder typologies: government, market, and community [9]. Governance and finance models and market-shaping strategies were then clustered, and an IM-integrated typology was developed, reflecting 'packages' of baseline governance, financing, and market-shaping strategies for decision making on NBS implementation. The context-specific operational approach was constructed using the WHAT–WHO–HOW framework based on the revision of 50 case studies. To support the development of tailored business models for the NBS projects, the sustainable business model patterns classified by Lüdeke-Freund et al. [35] were assessed regarding their suitability for NBS projects and linked with the elements of the NBS-oriented business model canvas [11]. Lastly, a web-based tool (IM preselection tool) offers applicable and adaptable models and patterns that facilitate the building of implementation models tailored to specific NBS projects and their contextual conditions. The IMs provide decision-makers with more precise and effective strategies that should be co-created with the key stakeholders involved in the NBS project. The IM preselection tool aims to support the process of determining which different governance models are the most appropriate for different financing schemes and defining the appropriate ele-

ments for the business opportunity that the NBS project represents, taking into account context conditions.

In a parallel perspective, the REGREEN project applied a conceptual framework of governance architectures for the integration of institutional and governance structures with local cultures for co-creation and adoption of NBS in policy and planning to develop innovative policy platforms on which NBS business initiatives can be maintained and developed with public support and partnerships.

Regarding co-creation, the H2020 project, Clever Cities, piloted a novel co-creation pathway to engage citizens in the design and implementation of a shared governance process for NBS [36]. This approach involved engaging and empowering multiple stakeholders to participate in urban innovation partnerships through the medium of urban living labs. The findings indicated that this approach led to an increase in awareness of the social benefits of NBS while simultaneously providing a mechanism to address spatial, financial, and governance challenges. The findings included a recommendation that such co-creation approaches be embedded in urban-planning practices to lead to increased acceptance of shared-governance processes. Lessons learned from this process indicate that co-creation remains a challenge for many stakeholders and that it can be demanding in terms of effort, time, and money.

The need to consider these interdependencies between co-creation, governance, financing, and business model design choices was also found to be crucial within the H2020 NAIAD project. This is critical to ensure the design of an implementation arrangement that not only guarantees the delivery of the NBS project but is also effective in maintaining long-term sustainability in service delivery. NAIAD further developed the Financing Framework for Water Security (FFWS) adapted to the NBS [37], which enables a process of transdisciplinary collaboration that engages the (infrastructure) financing community and the proponents of the NBS in designing fit-for-purpose project delivery and finance arrangements for hybrid (green–grey) projects [38]. By considering the transaction or project characteristics (financial and technical), the level of service required over time, and the institutional setting in which the project is to be implemented, these stakeholders can come to a shortlist of the most effective implementation arrangements. Guided by key questions and a repository of good practices worldwide, the proponents of hybrid solutions can choose from a wide range of project delivery and finance options. This range varies from purely public governance options to the creation of regulated markets that support the emergence of private initiatives and innovative business models. The four main families of implementation arrangements identified for large-scale NBS for water security are: (a) public procurement (including traditional as well as PPP contracts and even unsolicited private sector proposals), (b) privately driven water stewardship investments, (c) collective investment schemes, and (d) environmental markets [37]. The implementation of a full watershed-scale NBS plan may involve a combination of these different models and may require some minimum institutional conditions for their successful implementation. If some of these conditions are not present, one would need to adapt and tailor them to ensure the appropriate incentives are put in place. Within the FFWS conceptual framework, business models fit into this process of implementation arrangement design as a conceptual or qualitative narrative that may enable private actors to capture value from the main services to be delivered.

To secure additional financing for NBS, cities, and regional authorities are increasingly involving other actors (companies, investment funds, insurance firms, citizens) through alternative financing solutions. Such financing solutions have been documented by recent H2020 projects, such as H2020 GrowGreen, and the EU Urban Agenda partnership on NBS. To raise funds for NBS, several cities have imposed tax increments and established offsetting funds for developers. Some cities have even issued green bonds, and ensured that NBS is well embedded into the project selection framework. At the same time, the range of donation-based instruments is evolving to include entities, such as multi-actor funds, crowdfunding platforms, and stewardship programs. The emergence of institutional

funds or insurance firms investing in or incentivising NBS is ongoing, as is the piloting of credit lines for the incorporation of nature-based elements in both public and private urban projects. The Natural Capital Financing Facility (NCFF) of the European Investment Bank is one such facility. However, each financing mode requires a corresponding adaptation of the business model. To test how business models and financing sources can be aligned to realise urban NBS, the REGREEN project will test the possibility of using crowdfunding for projects with high social value capture. This endeavour will explore citizen's willingness to participate in NBS projects from beginning to end—from selection to co-creation and implementation of the project, and, eventually, its maintenance.

3.3. Importance of Integrated Planning as a Constraint or Enabler of Governance, Business Models, and Financing for NBS Deployment

Due to their central role in urban development, formal spatial and urban planning instruments are considered both enablers and barriers to the successful implementation of NBS [39,40].

Traditional planning approaches in regional and city master plans constrain the restoration, development, and sustainable management of green infrastructures in urban areas. In response, the mainstreaming of integrated urban planning and adaptive management approaches has the potential for transformative change, facilitating the deployment of NBS and enabling the mobilisation of the resources that support their effective implementation [41] and integration in wider—and prioritised—strategic policy agendas across the traditional silos of planning and policymaking.

Local governments play a key role in the design of projects to transform urban areas sustainably. Depending on the administrative structure in question, many authorities will have responsibilities, resources, and capacity covering urban planning, water supply, sewage networks, wastewater treatment, highways, management of public open spaces, environmental protection, and health. Despite this broad responsibility, urban greening efforts highlight a tendency towards silos and a lack of integration between departments [7]. To move towards a more integrated approach, urban planning teams play a crucial role. Not only do they have a broad spatial understanding of the urban area in question, but they typically work at the interface of both the environment and the market and thus are able to explore new forms of green investment.

Integrated spatial and urban planning approaches stress the transformative role of policy and institutional planning in addressing socio-economic and environmental challenges, such as the Sustainable Development Goals compiled by the United Nations. They also hold great potential to foster the development of more sustainable and participatory NBS projects that bring value to local communities. Acknowledging the different planning approaches and systems in place allows us to (i) anticipate potential barriers for the implementation of certain business, governance, and financial models; and (ii) identify opportunities and specific mechanisms that facilitate the articulation of those models.

3.3.1. Barriers to NBS Implementation: Examples of Traditional Urban Planning Models

Some examples of barriers found in the literature are related to land use regulations and restrictions (i.e., Land-Use Heritage Protection), strict sector policies (i.e., water quality), competing land uses, and conflicts between immediate revenues versus long-term sustainable public benefits, taxation schemes over value capture political logics, and distribution of roles and responsibilities over land and administrative silos. Several projects have found that urban planning codes often leave no space for the development of innovative solutions that can mitigate climate events. In some EU countries, for example, heritage protection rules hinder the development of NBS in areas where they are most needed; that is, in city centres [42].

Another barrier is the existence of administrative silos in many European cities, thus lacking the integration of financial resources, technical expertise, and strategic insights from the different departments that could contribute to their development [7]. This administrative rigidity further affects the development of innovative forms of governance and

business model development that require more flexible planning processes and enabling regulations. They prevent the creation of financial incentives for these green infrastructures to be developed in cooperation with stakeholders external to the city administration.

3.3.2. Potential of Integrated Planning to Allow New Forms of Governance, Market Development, and Green Investment

Clearing House and GrowGreen projects started from the premise that integrated spatial and urban planning disciplines and procedures are crucial enablers for transformational changes at the national, regional, and local scales, facilitating the deployment of NBS as well as the mobilisation of the resources that support their effective implementation. Indeed, business, governance, and financial models are articulated with formal planning and could be enhanced by tailored planning instruments aimed at facilitating the development of NBS. Clearing House and GrowGreen projects draw on best-practice case studies (see Appendix A), which offer an approach that is both scenario-focused and fully integrated within existing spatial planning frameworks. In these frameworks, environmental and community threats are perceived as interrelated rather than separate urban problems. By involving local communities throughout NBS development, these case studies provide important lessons on the relationship between urban planning, governance, and business models for NBS.

As argued above (Section 3.2), integrated planning and management cannot be separated from governance, as the processes of planning and implementation involve a wide range of stakeholders. However, there are multiple differences between planning systems, such as regional economic planning (French or Central model), the comprehensive integrated (German or Nordic model), the land use spatial planning and management (British model), and the urbanism tradition (Mediterranean model). Such differences, as analysed by Newman and Thornley (1996) and the EU Compendium (1997) [43,44], as well as by the literature on planning cultures [45–48], could lead to specific governance arrangements and particular combinations of business models. Furthermore, this would depend not only on the planning instruments and procedures in place but also on the social, environmental, and historical grounding of urban (and regional) planning and specific cultural contexts in which planning operates in reality. The GreenSurge EU project is one of the most recent and comprehensive studies in this direction.

In summary, understanding the planning systems and planning cultures in place is utterly important to define the most suitable governance and business models and to anticipate the required changes needed towards flexible integrated and successful planning.

3.4. Need for Adapted Tools for NBS Business Model Design and Implementation

As the complexity of NBS business models emerges from research, a need for tools to support NBS project stakeholders in developing business models has become evident and has been acknowledged by the European Commission [2]. This last section categorises the different types of business model support tools that were developed and applied in practice across different H2020 projects.

Three types of tools have emerged covering the following aspects (see Figure 3): (1) business model catalogues and examples of good practices to address lack of knowledge and raise awareness of the multiple forms of NBS business models, (2) interactive approaches engaging stakeholders in the co-design of business models, and (3) support tools offering more granular approaches to designing and planning business models for NBS, often applied in collaboration with stakeholders using the other methods.

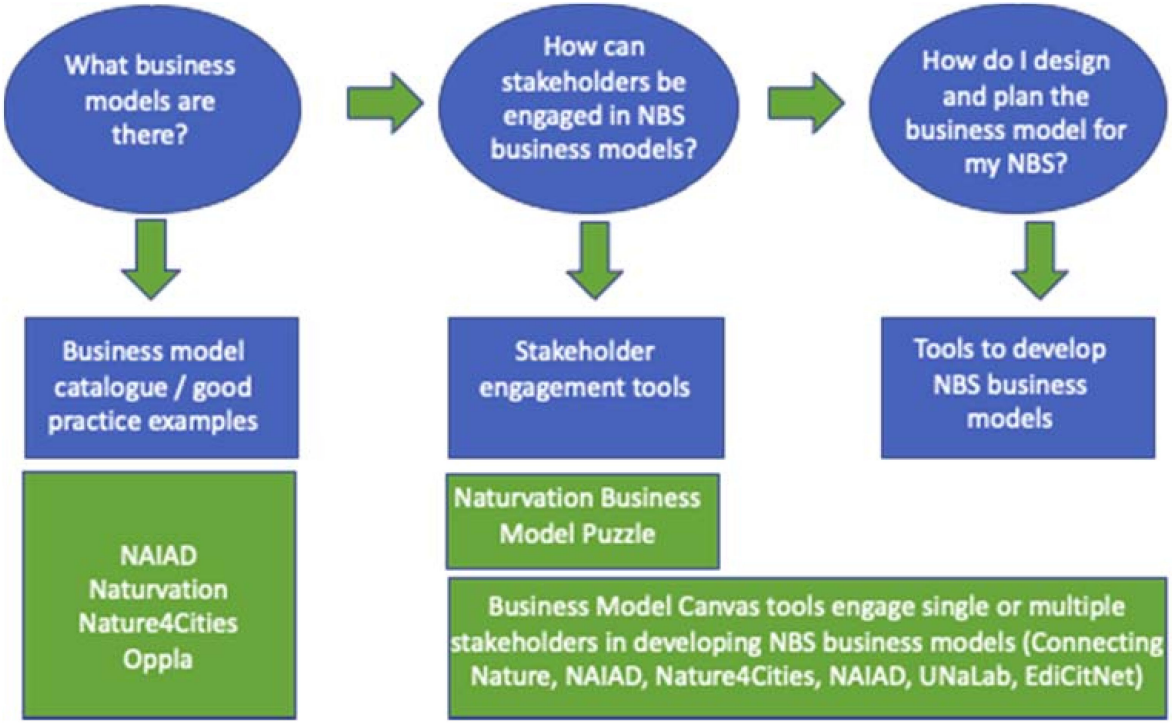

Figure 3. Three types of business model support instruments from H2020 projects.

3.4.1. Type 1: Business Model Catalogues and Good Practice Guides

NAIAD's collection of 'International Good Practices in Financing and Funding Nature Restoration' [49] presents a compilation of successful initiatives to fund and finance nature restoration projects, including but not limited to risk reduction projects. The collection is divided into two sections that offer analyses through two different lenses. The first section analyses a set of successful examples of NBS projects through a business model lens by applying the natural assurance scheme (NAS) canvas framework. This NAS framework is a linearised sequence of clusters and steps to intuitively identify and describe all the components of a business model, following a market logic for service provision: from supply through to demand, and leading to impact [49,50]. The second section reports on a set of successful examples of funding and financing mechanisms for ecosystem restoration initiatives, including facilities and instruments. This collection thus provides an overview of the evidence of existing successful examples of business models, instruments, and facilities for the funding, financing, and implementation of NBS projects.

The Naturvation business model catalogue [26] is an illustrated, practitioner-facing description of the eight different business models found to drive the uptake of urban NBS (see Table 1 for an overview of the models). The catalogue showcases 16 examples of NBS interventions, providing two illustrations per business model type (one from outside Europe and one from inside Europe). For each example, a short description of the value proposition, value delivery, and value capture is provided [51], along with enabling conditions and risks for each case.

3.4.2. Type 2: Stakeholder Engagement Tools

A key challenge for the financing of urban NBS is how to engage multiple stakeholders to contribute to their delivery and stewardship, based on the multiple benefits that can be captured through a single NBS intervention [27]. The Naturvation business model puzzle is an interactive dialogue tool that was developed to facilitate this process, to be used in stakeholder events and workshops to cross silos between stakeholders and identify and build business models in an easy and playful way. It offers a 4 × 4 puzzle template for stakeholders to use as a physical artefact for dialogue to identify (1) the types of benefits

that are present in a specific NBS they want to deliver and (2) which stakeholders might want to pay for these benefits. Stakeholders can then 'mix and match' business models from the Naturvation business model catalogue that fit the uptake of their NBS. The puzzle was tested at many events and is downloadable, including a video explaining how to play the game.

3.4.3. Type 3: Business Model Planning

Business model canvases are commonly used as a starting point for the design and planning of more detailed business models for NBS. These canvases help identify the required components of a business model and organise the information with the goal of communicating to investors, promoters, and the public. Some of the NBS-adapted canvases produced within the H2020 framework are the Connecting Nature NBS business model canvas, the NAIAD NAS canvas, the EdiCitNet canvas for ECS, and the Think Nature canvas.

The Connecting Nature H2020 project also originally conceived their NBS business model canvas tool as a stakeholder engagement tool, aimed first at bridging internal departmental silos in public sector organisations through increased understanding of the multiple benefits of NBS, and secondly at facilitating engagement between public, private, and communities based around a shared understanding of the multiple benefits of NBS. The original workshop format has evolved to include support tools, such as wall charts and guidebooks, which are available through the Connecting Nature project website. The simple visual format of the Connecting Nature NBS business model canvas, inspired by the original Osterwalder and Pigneur canvas [20], led to frequent recognition among business stakeholders and was easily picked up by non-business stakeholders. An important observation from stakeholder engagement workshops was the critical role of an experienced facilitator or bridging organisation with knowledge of NBS in facilitating a productive stakeholder engagement process [52]. The use of experienced facilitators with good knowledge of business model canvas tools but poor knowledge of the multiple benefits of NBS led to poor outcomes in one city workshop and prompted the elaboration of a comprehensive guide to the NBS business model canvas by the Connecting Nature project.

The connecting NBS business model canvas differs from the original canvas in a number of ways. The central concept of value proposition has been expanded to facilitate a reflection on the broader environmental, social, and economic value propositions associated with NBS. The term *Key Beneficiaries* has been used instead of *Customer Segments*, which broadens the consideration of possible 'Customers' to include indirect beneficiaries from impacts such as improved air quality. *Key Partners* and *Key Beneficiaries* have been positioned side-by-side to reflect the synergies that often exist with NBS between partners and beneficiaries. For example, the community is often the key beneficiary but is often also a key partner in planning and increasingly stewardship. Lastly, *Governance* is added as a specific dimension to the NBS business model canvas, reflecting the central importance and challenge of governance structures in sustainable business models [11]. The guidebook has been requested by over 150 organisations in more than 20 countries and translated into Spanish by third-party organisations [11].

Building on the experience of Connecting Nature, the business model canvas approach was also used in the UNaLab H2020 project to plan NBS in the cities of Eindhoven, Tampere, and Genoa. The UNaLab handbook identifies this canvas as 'an easy and effective tool to engage the municipalities in the business model analysis of their NBS,' and overall found this method 'has proven exceptionally useful' [53]. However, certain limitations were also noted, particularly the high dependency of the results on the variety of stakeholders involved in the analysis. UNaLab identified that while local government representatives might be the optimal stakeholders to highlight the social and environmental value of the NBS, sometimes they may fail to identify the direct and indirect benefits for the private sector. UNaLab recommended the involvement of both public and private stakeholders in such analysis as essential. The challenges in capturing NBS direct value for the private

sector were acknowledged. Approaches such as biodiversity and natural capital accounting may help bridge this gap, providing increasingly robust mechanisms to quantify the multiple values of nature as an asset [53].

NAIAD's NAS Canvas spans all three types of business model support instruments under the framework of the H2020 NAIAD project. The NAS Canvas framework and tool have been developed as an adapted version of the traditional business model canvas tailored for the analysis and description of business models for NBS, particularly those aimed at disaster risk reduction (DRR). The NAS canvas follows and reflects the flow process of services generated by NBS providing natural protection against climate hazards and how their associated value is generated and captured in both the supply and the demand sides of service provision. It then guides the identification and description of the actors and elements required in this process, thus providing the key ingredients for the creation of one or several business models to catalyse the provision of the service through the implementation of the NBS. The NAS canvas also builds on the traditional business model canvas by Osterwalder and Pigneur, and is enhanced to include elements from the business hub extended canvas and NAIAD's economic framework to incorporate the particularities of NBS as providers of intangible–common goods. The NAS canvas and framework are presented studies by Mayor et al. [54] and Mayor et al. [50], which included the application of the tool to describe business models for a variety of NBS-based natural assurance strategies in nine demonstration cases with different scales across Europe. The NAIAD NAS canvas has also been used effectively as a multi-stakeholder approach to co-creating new business models for NBS.

The ECS business model canvas developed by the EdiCitNet project aims to support entrepreneurs and businesses along the value chain of Edible City Solutions (ECS) by offering a tailor-made business consultancy based on a sustainable business model canvas. This bespoke service will complement the resources of the EdiCitNet marketplace, which analyses common barriers and obstacles for businesses in this sector and serves as an action-oriented, multi-sided platform for entrepreneurs and businesses promoting visibility and brokerage. Due to the diverse field of ECS, ranging from urban agriculture to building-related installations, a vast pool of different business models and business plans is explored, structured by categories and thematic clusters.

The ThinkNature Handbook focuses on building a business case for financing rather than business models for NBS per se. Natural capital approaches are suggested as a potential framework for building a clear case for investment [41]. The NBS Business Model Canvas is identified as a tool that can be used to assess the impact of NBS, to enable the clear identification of key stakeholders, and to explore how they can be engaged through different governance models. Recognising the complexity of building business models for NBS, ThinkNature proposes a two-step project initiation approach. The first phase, 'SITE4NBS', provides an evaluation framework that engages stakeholders in considering the resource investment required for NBS over different scales and timeframes. This high-level overview then feeds into the second 'RISE4NBS' phase, which includes four elements: research on risk, regulations, and policy settings, an investigation of different investment options, collaboration with stakeholders and beneficiaries, and an evaluation of socio-economic and environmental impacts.

Finally, it is worth mentioning again in this section the fourth more transversal category of tools that considers the interphase between business models, financing, and governance previously presented in Section 3.2: the Financial Framework for Water Security developed by the NAIAD project, and the Implementation Model developed by the Nature4Cities project.

4. Discussion

Our scoping paper has identified some of the main challenges constraining NBS implementation, and how these stimulated the consideration and conceptualisation of the business models concept as a potential tool to support NBS upscaling. It has also presented

the advances and findings of a set of H2020 projects on NBS business models, unravelling and operationalising the key opportunities and enabling conditions while detecting and highlighting the remaining challenges.

One of the first issues identified across all projects concerned the use of the term 'business models' in the context of NBS. Business models are commonly associated with business entities, yet NBS are not enterprises but rather sustainability interventions. While the merit of business models is recognised, particularly in their fit with nature as a 'solution' to certain needs, critiques are also found around the use of the term 'business models' in relation to NBS. This is due to generating the perception that urban nature could/should be profitable and/or should be privately funded, which raises justice concerns [55].

Related to this consideration, the question also arises as to whether public actors should refer to a 'business model' for NBS, which may further raise expectations of an economic valuation of nature. In reality, many NBS can be identified as public goods (shared by many, difficult to charge for usage) or common-pool resources (limited public resources to be shared among many) that do not lend themselves easily to private sector 'pay-per-use' or similar revenue-generating models. Therefore, the use of 'business model' terminology should be considered carefully and contextualised appropriately when applied to the case of NBS. Although the merit of applying the business model concept is apparent in the current work, we suggest further theoretical reflection on the appropriateness of the business model concept in the context of sustainable interventions, such as NBS.

On a second reflection, the authors hereafter discuss to what extent the described work on developing, operationalising, and applying the business model concept for NBS by the pool of H2020 projects represented has contributed to partially address and/or understand the following driving challenges.

The first challenge introduced was related to the significant financial needs for mainstreaming implementation, which so far have mainly fallen on public sector budgets, while the private sector remains poorly engaged in NBS investments. In this line, the work done by the projects represented by this author team on exploring, mapping, documenting, and piloting different options and alternatives to support public funding mechanisms that provide guidance towards blended finance options and initiatives. Meanwhile, the participatory and grounded approach of most of these projects through the testing of concepts and tools in case study pilots has also allowed the involvement of private sector actors on the ground with three outcomes: raising private sector awareness and evidence of NBS performance, identifying barriers and levers for private sector involvement, and starting conversations between private and public actors on co-financing NBS. Here, the role of supporting tools as well as co-creation approaches that involve stakeholders have proven key to realiing impact at the intervention scale. A pending issue in this sense is how to upscale such effects for the widespread reach and involvement of the private sector on a higher scale.

A second related challenge was the need to make NBS value explicit and measurable, both in monetary and non-monetary terms, to attract the interest and ex ante perception of benefits from both public and private actors. In this sense, the presented advances on defining, understanding, and classifying NBS value propositions and typologies, as well as creating tools to support the eliciting, describing, and documenting of the value capture process, are important contributions towards making explicit and communicating value to public and private actors and potential investors. These efforts to clearly present the business models should go hand in hand with—and actually capture—the results of previous economic and qualitative valuations of NBS benefits and co-benefits, which in many cases have also been explored and integrated within the H2020 project frameworks. As a particular example, NAIAD's NAS canvas integrates the results of the economic assessment of the benefits and co-benefits stemming from the application of the economic valuation framework developed within the project [56]. Nevertheless, it remains true that, even where the economic valuation of NBS can be captured, in many cases, such valuations are not convincing to private investors, as the economic benefits are presented as savings

rather than revenue-generating opportunities, and they often accrue in the future (e.g., long-term climate reduction impacts), rendering such investments less attractive than alternative investment projects that present more immediate returns. This well-known preference for short-term rather than distant successes (hyperbolic affective discounting of the future) makes the importance of considering alternative valuation approaches even more evident [16], and further research needs to be conducted in this respect. Another area for further research is the exploration of trade-offs between the different value perceptions of various stakeholders.

A third challenge is the focus on financing for upfront capital investment while overlooking the importance of securing financing for operational or maintenance costs, which can constrain the economic sustainability of the project in the long term and deter upfront investment appetite. To address this challenge, it has been acknowledged that generating revenue to sustain ongoing costs should be addressed as part of the overall business model. The set of tools presented under Type 3 in Section 3.4 includes several variations of business model canvases that precisely address the identification and documentation of business models for NBS. These business model tools facilitate the disaggregation and identification of both potential funding streams (aimed at covering the upfront capital costs) and revenue streams along the project lifetime that can contribute to operational and stewardship costs. Revenue streams are, in fact, one of the key elements of a business model, which in many cases will require the involvement of new beneficiaries (including indirect beneficiaries of NBS co-benefits) willing to pay on a concurrent basis for the provision of nature-based services. The clear need for innovative formulas here has been channelled by most H2020 projects through adding a participatory co-creation component to their tools that ensures a bottom-up approach, giving voice to the project promoters and potential beneficiaries about how they would actually be willing or able to pay to jointly have those costs covered, or to commit resources in another way (i.e., volunteering).

The fourth challenge referred to the silo gaps in the public sector caused by the lack of collaboration across departments and thus the continued dependency on traditional funding channels and approaches. As reflected in Sections 3.2 and 3.3, several projects have advocated the importance of considering finance, governance, and integrated planning, with co-creation as a transversal tool to connect them all, as critical to allow overcoming those silos and bringing new actors to the table, including the private sector. The involvement of a multitude of actors in financing NBS presents both benefits in terms of broader stakeholder buy-in and added complexity in terms of governance and business models. Meanwhile, a deeper analysis of the role and potential of urban and land use planning within governmental structures, as presented in Section 3.4, has argued how, when adopting a more integrative approach, urban and land-use planning teams are well positioned to play an important role as both enablers and conditioners of change due to their broad spatial understanding as well as their work at the interface of both the environment and the market, and thus are able to explore new forms of 'green investment'. Urban planners, architects, and landscapers can be key stakeholders to catalyse the integration of NBS within the planning system, with added value from collaboration with other disciplines in a broader set of stakeholders and disciplines brought by co-creation and participatory processes towards integrated planning.

After this overview of the contributions and emerging challenges, the authors acknowledge a series of limitations of the research presented in this article, as well as detected gaps in the overall progress achieved and the need for further work.

Referred to the limitations of this research initiative, one first limitation is the consideration and revision of a subset of the array of H2020 projects currently working on NBS and addressing this business model concept. This limitation leads to some bias and an incomplete overview of the full set of advances achieved within the programme. Linked to the previous one, a second limitation is that the research only considers progress made within the frame of the H2020 projects. The authors acknowledge additional advances in knowledge and tools on business models for NBS made by the research community

that are not covered in this research. A third limitation is the fact that some of the projects participating in the research are only at a very initial stage; only very preliminary or superficial results could be presented. Nevertheless, the authors' team considered it worth including mention of those projects and their research focus in order to provide the readers with initial information and the relevant sources where they can follow up on progress and expected results.

Regarding the gaps in the achieved progress, the current research and piloting were mostly carried out in the European urban context, with a few exceptions (NAIAD and RECONECT) contributing at the catchment/aquifer scale, and NATURVATION also including cases from cities outside Europe. Further research is required to develop and juxtapose business models for urban and rural NBS, as well as to embed research from other continents, including the developing world. In this case, we foresee important differences in outcomes. The rural context can potentially provide larger-scale investments, supporting environmental/economic business cases for NBS. Furthermore, other stakeholders, such as farmers, may become involved in the rural context.

As the current wave of H2020 projects on (urban) NBS has largely commenced since 2015 (European Commission, 2015), evidence and evaluation on the long-term impact of the business model approaches presented in this paper is still lacking. While European funded projects have provided a valuable initial conceptual exploration of the concept and the emergence of typologies and tools to support NBS business model development and are therefore laudable, there remains a lack of empirical evidence to indicate the long-term impacts of such business model approaches. Longitudinal studies measuring the transition in business models, governance, and financing of NBS would provide a much-needed complement to this initial study.

Co-creation, or co-production, is often cited as a prerequisite for the planning and implementation of NBS. This may involve 'internal' co-creation bridging departmental silos in municipalities/public bodies (urban planners and other departments, for example) or 'external' co-creation bringing multiple public, private, academic, and community stakeholders together to co-create and co-produce NBS. The concept of co-creation would appear fundamental in the development of hybrid financing approaches and collaborative business and governance models, but due to space limitations, there has been limited exploration of co-creation theory in this paper. Further papers that consider business models and financing through the lens of co-creation/co-production theory could provide useful insights for both fields.

Another key topic that interferes with successfully applying business models to NBS is the uptake of valuation tools that are able to account for the plurality of NBS performance. Natural capital accounting and other tools that are being developed across H2020 projects for NBS play a crucial role in realising business models for NBS by enabling actors to capture, strategise, and communicate NBS benefits.

5. Conclusions and Recommendations

When the concept of NBS to societal challenges was first defined by the EC in 2017, financing was recognised as one of the major challenges to mainstreaming this approach. The complexity of the NBS and the multiple stakeholders involved obscure the argument for both public and private sector investment. Knowledge of funding and business models for NBS, particularly in an urban context, was emergent at that time. In the intervening 5 years, subsequent waves of EU research- and innovation-funded projects have resulted in substantial contributions to this field of knowledge. Collaborating and sharing knowledge through an EU Task Force, the first wave of EU projects laid important knowledge foundations, reviewing existing literature, and compiling empirical evidence of different financing approaches and the business models that underpinned them. Subsequent waves of EU innovation actions advanced this knowledge base, developing and testing new implementation models, and business model tools and approaches. This paper presents the findings of these projects in their application of the lens of business model theory to simplify the

complex value propositions of NBS. Notwithstanding the need for further research, this study concludes that business models are a vital tool in the arsenal of NBS project promoters, facilitating the engagement of public, private, and community stakeholders in setting out a consensual roadmap for the long-term sustainable financing of NBS.

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Appendix A

Examples of urban planning approaches.

Example A1. *NBS Adaptation Pathway to cope with surface flooding in Manchester.*

The nature of urban morphology presents its own challenges. In addition to the spatial constraints presented by the compact design of European cities, the complexity of the existing grey infrastructure (much of it underground) means that some solutions require a green or blue footprint which is unavailable. As a result, interventions will often need to be considered which successfully integrate both green and grey infrastructure. The use of a complementary approach has been identified by scholars as a pragmatic and effective means of accounting for morphological constraints whilst at the same time promoting urban sustainability. Within the GrowGreen Project, Manchester city is co-creating an NBS Adap-tation Pathway, exploring and combining different solutions to deal with surface flooding, and generating spatial data, which will over time inform planning decisions and investment opportunities. The NBS adaptation pathway approach helps to work towards a common strategic vision and clear objectives, overcoming political logic and administrative silo thinking while responding to social demand. This required substantial government commitment.

Example A2. *Co-design methodologies for the conception and delivery of Urban Forests- Based Solutions in Europe and China.*

The importance of the co-design approach is increasingly recognised in the planning of NBS in dense urban areas, where conflicting interests and limited space availability complicate urban development projects. Indeed, beyond agreeing on the importance of setting up participatory processes for policy-making, the CLEARING HOUSE H2020 project applies a co-design and co-learning methodology to the development of tools and guidelines that will aid in the design, governance, and management of urban forests in its 10 case studies of cities and urban regions in Europe and China. Through these case studies,

the project partners will stress the need to promote the participation and collabora-tion of a variety of local actors from all sectors of society. This approach, commonly referred to as the Quintuple Helix approach in the literature, allows for the pooling of resources and knowledge of local actors to co-design urban services and infrastructures.

The co-design approach allows urban planners and city representatives to design NBS that integrate the needs of users and the environmental priorities of local ecosystems while leveraging the financial resources and knowledge of local stakeholders. In this way, co-design initiatives are successful in mainstreaming NBS into urban planning processes.

Example A3. *Multi-scale perspective: from regional and local planning schemes in the city of Valencia.*

With the slogan 'Climate proofing urban planning through NBS,' the City of Valencia is delivering an NBS Strategy in the context of the H2020 Grow Green project. The NBS Strategy builds on existing very valuable information generated at the regional and city level in relation to climate change hazards, vulnerability, and green infrastructure, as well as strat-egies and planning instruments that reflect the efforts of the city council to move towards adaptation. The NBS strategy focuses on identifying NBS as adaptation measures to cope with the key climate hazards faced by the city and embed-ded the criteria and guidelines for urbanisation incorporating NBS into the current Local Master Plan. The strategy also explores the business and financial models supporting the deployment of such NBS.

Example A4. *Evidence-based planning decisions and benchmarking alternative planning scenarios: Sustainable Pocket Forest in Valencia.*

Benchmarking alternative planning scenarios is conceived as a best practice. Scenarios are an effective way to deal with the uncertainty inherent to complex systems and a lack of data. Co-designed NBS interventions in the Benicalap district in Valencia has been benchmarked using modelling exercise to comparatively assess their effectiveness against thermal comfort and co-benefits, and to decide which ones have less significant impacts and maximise the green infrastructure network and provision of ecosystem services in the city. A co-creation approach involving a whole range of stakehold-ers, from institutional decision-makers to local residents was applied.

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